

ECOLOGICAL NOTES ON CYMATIA AMERICANA (CORIXIDAE, HEMIPTERA).

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(Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 189, and from the Entomological Laboratories of the University of Minnesota.)

I. A REMARKABLE MODE OF HIBERNATION.

The hibernation of the waterbugs is a peculiarly interesting subject, and one about which comparatively little is known as yet. Certain species, notably the surface-dwelling forms, pass the winter under logs, mats of grass, and other debris at the margins of the ponds and streams on which they are found during the summer. It seems that they must certainly endure temperatures far below the freezing point, especially in the more northern parts of their ranges. The truly aquatic forms, living in the open water, are commonly reported to hibernate deep in the mud at the bottom of the ponds; and here the temperature probably never goes below the freezing point in normal winters.

To these two types of hibernation may be added a third, to be described below, which is truly unique: here the bugs pass the winter sealed in small cavities in the ice which covers the ponds in which they dwell in summer. This peculiar mode of wintering was observed at a small pond at the northeast corner of the University Golf Links, a little over half a mile north of the University of Minnesota Farm School in St. Paul. This pond is roughly trapezoidal, about 75 yards long and 40 yards wide at its widest point. A roadway has been built through the pond, cutting off a small part near the south end. The bottom is very soft mud, and, especially in the larger part, the pond has only a very scant growth of aquatic vegetation.

Collections made here in September and October of 1918 showed the hemipterous fauna of these ponds to be fairly typical of the north-central United States. Various species of Corixidæ were found to be the most numerous of the waterbugs, and most

abundant of these was *Cymatia americana* Hussey. In connection with the description (BULL. BROOKL. ENT. SOC., xv, p. 82, 1920) of this species, I noted that it had been found hibernating in a very peculiar situation, and stated that further investigation of this habit was planned. However, owing to the great scarcity of material during the following winter, I was unable to carry my studies further; and as I am no longer located in a region where this species occurs, it seems advisable to publish the data which I have.

On January 15, 1919, I went to these ponds for the purpose of obtaining specimens of *Buenoa margaritacea* Bueno for experimental work in the laboratory. At this time about ten days of very mild winter weather had followed four or five days of zero temperatures, and the ice on the ponds was only about eight inches thick. I had chopped down to a depth of about six inches over an area about a foot square before the axe broke through and the hole filled with water. At the next stroke of the axe some twenty or thirty Corixids, of the species referred to above, appeared and floated up to the surface, where they remained motionless. I collected these, and soon had obtained seventy or eighty more in the same manner, all apparently coming from below the ice. Then a block of ice about six inches square and two or three inches thick was broken off, and I discovered the source from which I was obtaining at least a part of the specimens.

In the ice itself, from half an inch to an inch above the water, there were several small pockets, the largest of which was less than an inch and a half in diameter, and in these the Corixids were tightly crowded in groups of from ten to fifty individuals. Some of the pockets had small open passages leading into them, which may possibly have communicated with the water or with other pockets; but others were entirely sealed in by the ice. In some cases which I found later there was a space of two or three millimeters between the mass of bugs and the wall of the chamber. No bugs were found singly and only the one species was found hibernating in this manner. In all, I collected nearly three hundred specimens from an area of little more than a square foot. The water here was about fifteen inches deep below the ice.

When the specimens were taken into the laboratory and placed in warm water, they all revived. The bugs which were placed in water at a temperature of 14° C. first began to show movement after twenty minutes, while others placed in water at 20° required only about half that time. The first movements observed were spasmodic twitchings of the hind legs; after about five minutes more the bugs began to pass their legs over the hemelytra, thus covering them with a film of water, and attempted to dive. Flashing a strong light directly above the dishes containing the bugs provoked strong reactions which persisted for perhaps half a minute if the light remained on, but which died away almost immediately if the light were merely flashed. At this time only a few individuals were able to break down through the surface film, the others being able merely to swim about in an erratic manner over the top of the water. In all nearly forty minutes had passed before any of the bugs were able to grasp pebbles or plants in the shallow aquarium and so to remain submerged, and only after an hour were they able to swim downward in a normal manner.

About one fifth of the boatmen died within twenty-four hours after they had been revived in this manner; this may have been due largely to shock from the sudden change of temperature. A considerable number of individuals were still alive, however, when I left Minneapolis some six weeks later.

Experiments were begun at once to discover the manner in which the Corixids get into the pockets in the ice, but they had hardly been started when I was forced to abandon them for a time.

When I returned to Minneapolis in the fall of 1919, I made several trips to this pond and to the other ponds in the vicinity, but it was not until November 17 that I obtained any individuals of this species, though several species of *Arctocoris* were plentiful. On this date the pond was covered by about two inches of ice, and the single female *Cymatia* seen was swimming rather sluggishly in the open water near the bottom, where the water was about fifteen inches deep. A week later a single male was taken in the same place, and during December a few other individuals were also secured here. Meanwhile the other Corixids

(*Arctocorisa* sp.) became less numerous, and finally, on January 9, none were seen; on this last date five specimens of *Cymatia* were taken from under the ice, which was now about twenty inches thick, and which showed no trace of the air-pockets in which the bugs had been found the previous winter.

These last five individuals were all torpid. They were taken back to the laboratory in ice-water, and gradually warmed to room-temperature, but none of them survived. The only movements made by any of them were spasmodic twitches of the legs and were induced by flashing a strong light over them.

At present we can give no answer to the many interesting problems which are suggested by these observations, such as the manner of formation of the air-pockets, the entrance of the bugs into them, the occurrence of but the one species of Corixids in the pockets, the fact that no individuals of *Cymatia* were found singly and frozen tightly in the ice, whether this mode of hibernation is merely accidental in *Cymatia*, or is characteristic of the species. All of these are problems which merit investigation, and I regret that I have been unable to continue my studies of them.

II. NOTES ON THE FOOD HABITS OF *Cymatia americana*.

Until recently it has been very generally stated by writers on the aquatic Hemiptera that the Corixidae are carnivorous insects. But Hungerford (Science, N. S., xlv: 336-337, 1917; Jl. N. Y. Ent. Soc., xxv: 1-5, 1917; Kans. Univ. Sci. Bull., xi: 234-249, 1920) has shown that various species of *Arctocorisa*, *Palmarcorixa* and *Rhamphocorixa* commonly feed upon organic ooze which develops on the debris in the pools which they frequent, and that they are primarily herbivorous insects. And the structural adaptations of the head and of the fore-legs are indeed admirable for their mode of feeding.

The structure of the head and of the mouth-parts of *Cymatia* is essentially the same in *Cymatia* as in the other genera of the family; but the adaptations of the long cylindrical tarsi (palae), with their rows of long bristles (for figures of the palae of *Cymatia*, see BULL. BROOKL. ENT. SOC., vol. 15, pl. 1, 1920), for this type of feeding is much less obvious than in the case of Arc-

tocorisa, etc., where the palae are shorter and broader, and flat or even concave on the side which is applied to the face in feeding. In fact, the structure of the palae in *Cymatia* is such as to suggest carnivorous habits, the palar bristles as well as the long movable terminal claw indicating their use in the retention of prey.

That these structures are employed in this manner has been observed directly. For about ten weeks during the winter of 1920-21 I kept a pair of *Cymatias* in a small balanced aquarium on my table. On November 24 several larvae of a *Corethra* were placed in this aquarium also, and a few days later one of the Corixids was seen to be feeding on a *Corethra*, holding it tightly pressed to its face by means of its front legs; but the *Corethra* was released before I could make any close observations.

On December 19 the stock of *Corethras* had become exhausted, and more were added to the aquarium. Almost at once one of the *Cymatias*, which was at rest on the bottom, struck at one of the larvae, but missed; it then floated up toward the surface, directly under another of the larvae. When about one centimeter below the *Corethra*, the bug gave a quick stroke upward, turned on its side, seized the larva, and swam down to the bottom, where it proceeded to feed on its prey. The *Cymatia* held the *Corethra* closely pressed against its face by means of its front legs, the palar bristles of which crossed each other forming a sort of net which helped to hold the prey, while the palar claws were bent nearly at a right angle with the pala and closely pressed against the larva. The mandibular and maxillary stylets of the *Cymatia* were protruded considerably from the oral aperture, and were worked rapidly back and forth in the body of the larva. After twenty minutes the *Corethra* ceased to move; though at first its struggles were so strong as to dislodge the Corixid's hold on the bottom, they were not sufficient for it to escape. During the feeding process the Corixid manipulated the *Corethra* somewhat, sometimes holding it straight and at other times in the form of a U. After sixty minutes the bug came to the surface for the first time after it began feeding, and ten minutes later the *Corethra* was dropped, now shrunk to about two-thirds of its normal length.

While these observations were being made the other *Cymatia* also captured and fed upon a *Corethra* larva. The details of feeding were essentially the same in this case as in the other. During the time when they were under my observations, about ten weeks in all, the two Corixids continued to feed upon the *Corethras*, each one taking about one each day, on an average. I also observed them strike at Entomostracans several times, but I can not say whether these were eaten or not.

There is nothing in these observations, of course, which proves that *Cymatia americana* is not herbivorous as well as carnivorous; and Hungerford has stated that even the forms which are primarily herbivores will, under extreme conditions, attack *Chironomus* larvae and small worms, and it may well be that this is such a case. Further observations on the food habits of *Cymatia*, especially in summer, are necessary to decide this point. However, in view of the predaceous adaptations of the palae, I am inclined to believe that *Cymatia* is primarily predatory. It may be worth mentioning that the pond from which all my Minnesota specimens of *Cymatia americana* were taken has a large *Corethra* population.

These studies of *Cymatia* were undertaken at the Entomological Laboratory of the University of Minnesota, under the direction of Professor Royal N. Chapman, to whom I wish to express my appreciation for his active interest in them, as well as for his valued assistance in the field work during the winter of 1919-1920.

Food Plant of *Cymus discors* Horv.—This bug was found in White Plains, N. Y., on the sedge *Scirpus polyphyllus* Vahl. on September 10. The insect breeds in the seed heads, now ripe and fuzzy, and was found concealed in them, from the 2d or 3d instar to the freshly transformed adult, two or three in each cluster of seeds. Each head harbored from twenty up.

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